NESDI Program Launches New Initiatives

Notable Efforts Include Improved Aircraft Engine Washing & Contaminated Sediment Strategy

THE NAVY ENVIRONMENTAL Sustainability Development to Integration (NESDI) program launched 15 new initiatives in fiscal year (FY) 2016 to address some of the most pressing environmental operational challenges facing the Navy. These projects seek, among other objectives, to demonstrate a new, more efficient engine washing procedure for use across the Naval Air Systems Command (NAVAIR) and develop a comprehensive investment strategy for contaminated sediment management.

Each year, the NESDI program collects environmental needs from across the Navy's shore community. Based on selected needs, project teams are formed to demonstrate, validate, and integrate innovative technologies, processes, and materials into fleet operations. In FY15, after a total of 62 needs were collected and 25 proposals to address those needs were received and reviewed, the program gave the green light to the following 15 projects:

1. Stable Carbon Isotopes for Tracing In Situ RDX Remediation (project no. 537)
2. Development of Advanced Primer and Superhydrophobic Topcoat for Corrosion Resistance and Leachate Impedance (project no. 538)
3. Forward Looking Infrared (FLIR) for Advanced Discharge Characterization (project no. 539)
4. Smart Electronic Tools for Navy Environmental Compliance Monitoring and Reporting (project no. 540)
5. Utility Vault Water Treatment (project no. 541)
6. Naval Air Systems Command Solutions for Engine Washing (project no. 542)
7. Preventative Management of Contaminated Silt (project no. 543)
8. Stable-Isotope Labeled Tracers, an Innovative Way to Validate Natural Attenuation of RDX in Groundwater (project no. 544)
9. In Situ Treatment of 1,4-Dioxane Using Enhanced Biodegradation (project no. 545)
10. National Pollutant Discharge Elimination System (NPDES) Copper Effluent Control System (project no. 546)
11. Demonstration of Improved Toxicity Methodology to Link Stormwater Discharges to Receiving Water Impacts at Navy Sites (project no. 547)
12. Sewer Gas Elimination Technology (project no. 548)
13. Demonstration of Optimized non-NMP (n-Methyl-2-pyrrolidone) Solvents for Immersion Chemical Depainting (project no. 549)

If provided with a scientific method for determining RDX degradation rates over site-specific spatial and temporal scales, site managers could more confidently implement successful remediation approaches.

14. A Comprehensive Analysis and Strategy for Contaminated Sediment Management (project no. 550)
15. Impact of Sediment Resuspension by Propeller Wash and Shore Sediment Dynamics on Remediation Options (project no. 551)

Stable Carbon Isotopes for Tracing In Situ RDX Remediation (project no. 537)

Munitions explosives contamination continues to concern Department of Defense (DoD) facilities, costing considerable resources in time and money for assessment, cleanup, monitoring and site closure. Acceptable limits of RDX (cyclotrimethylene-trinitramine) are very low, making accurate contaminant degradation measurements a high priority for site managers. If provided with a scientific method for determining RDX degradation rates over site-specific spatial and temporal scales, site managers could more confidently implement successful remediation approaches.

Most assessment methods for degradation rate estimation are based on indirect measures. These "lines of evidence" approaches are expensive and have little forecast capability. They fail to conclusively determine which of many factors and conditions are responsible for the degradation of RDX into its desired end product—carbon dioxide (CO_2).

The goal of this project, headed by Thomas Boyd of the Naval Research Laboratory, is to differentiate contaminant-derived CO_2 from CO_2 produced by the soil's natural respiration processes. The general approach is to target the contaminant's carbon backbone using isotopic analyses the most common being stable carbon analysis. This type of analysis has been employed by the Naval Research Laboratory to detect chlorohydrocarbons and munitions constituents in contaminated plumes at other DoD sites.

Carbon-13-labeled RDX will be released as a tracer into the groundwater at a U.S. Navy site (or sites). RDX with Carbon-13 is traceable into soil gas CO_2 and methane, under both aerobic and anaerobic conditions. Preliminary discussions have identified a site at Naval Base Kitsap-Bremerton Washington. This site meets many of the conditions that make it appropriate for a demonstration, and the site has regulator approval to release small amounts of RDX.

A natural abundance isotope ratio mass spectrometer—designed to work at per mil (1 in 1,000) resolution—will detect shifts in the CO_2 and CH_4 stable isotope ratios as RDX is degraded to these end-products. Sampling will be conducted seasonally and spatially for dissolved inorganic carbon (CO_2), dissolved methane (CH_4) and bacterial biomolecules in groundwater and if possible, soil. The sum of these measurements can determine the total degradation of RDX by natural methods (attenuation).

The end result of this project will be a protocol usable at sites with either engineered or natural attenuation remediation programs currently in effect. The team will develop a seminar to highlight the results of this project and resultant methodology and deliver it to affected Remedial Project Managers, regulators and other stakeholders.

Development of Advanced Primer and Superhydrophobic Topcoat for Corrosion Resistance and Leachate Impedance (project no. 538)

Galvanized metal is commonly used at Navy installations. This metal is also one of the main sources of zinc in stormwater discharges, and one of the primary reasons for potential regulatory compliance issues. Both the Navy and the Electronic Harbor Security Systems (EHSS) program

A FLIR camera can provide thermal imaging of the environment.

have a stake in protecting these galvanized structures and reducing zinc in stormwater runoff.

The EHSS has responsibility for over 60 sites worldwide with galvanized metal structures that are regularly subject to heavy salt spray which results in rapid corrosion. This can cause both zinc leaching and discharge, increased structural repair due to corrosion, potential damage to security equipment and potential downtime.

This project was formed as a partnership between EHSS, the Naval Air Warfare Center (NAWC) Patuxent River, Maryland and the Space and Naval Warfare Systems Center Pacific (SSC Pacific) in San Diego, California. The team, headed by Brandon Swope of SSC Pacific, and Alan Grieve of NAWC Patuxent River, will investigate two potential solutions to this problem—superhydrophobic coatings and inorganic zinc-free primers.

Galvanized metal is one of the major sources for zinc runoff in stormwater.
Chuck Katz

Volumetric superhydrophobic coatings are water-repelling coatings first developed by the oil industry. These coatings have undergone extensive testing for their anti-corrosion properties and showed no leaching whatsoever, making them far superior to any other coatings currently or previously in use. Superhydrophobic coatings are also considered a "green" technology because they're not biocidal and virtually eliminate zinc leaching.

Metal-rich coatings have proven to be highly effective in preventing corrosion in aggressive corrosion environments. Most of these products contain a zinc pigment, which leaches out into the environment. This type of pollution in estuaries and bays is a problem that can affect marine life. Zinc-free alternative coatings have been developed by personnel from the Naval Air Systems Command. These inorganic coatings have produced good results in accelerated testing and may provide an alternative to zinc-based corrosion prevention schemes while limiting heavy metal discharge.

Laboratory testing of the two products will be conducted at NAWC Patuxent River and SSC Pacific. After a suitable formula has been identified, field-deployed test panels will then be sent to various EHSS testing sites (based on operational availability) where high levels of corrosion occur, and assessed for corrosion in these environments over time. Additionally, scaffolding material will be coated and field deployed in an industrial shipyard setting

End users at EHSS will be involved with the demonstration of the product, and if successful, they will adopt the technology worldwide. Additionally, Navy facilities with permitting issues related to zinc leachate will be engaged during the project with the end goal being to include the product in future contractor requirements to apply these new coatings during the maintenance of galvanized structures.

Forward Looking Infrared (FLIR) for Advanced Discharge Characterization (project no. 539)

A mixing zone is an area in a water body immediately adjacent to a discharge outfall. Discharges may result from stormwater or other industrial activities such as cooling water. A mixing zone is defined by the U.S. Environmental Protection Agency (EPA) as an "allocated impact zone where numeric water quality criteria may be exceeded as long as acutely toxic conditions are prevented." Put simply, higher levels of metals and other contaminants are allowed in this zone, with the assumption that they will become diluted within the larger water body.

Hydrodynamic models have been developed to characterize the potential concentrations of contaminants and toxicity of these mixing zones; however they are not designed to address the issues of dynamic mixing for pierside/nearshore surface discharges (e.g., stormwater mixing).

It is the goal of this project, headed by Brandon Swope of SSC Pacific, to provide a means to better and more easily quantify and characterize a dynamic mixing zone as well as provide more data for these models through the use of a new technology. This will allow for the better linking of small and large scale hydrodynamic models.

A FLIR camera can provide thermal imaging of the environment, which can aid in developing highly accurate data associated with outfall discharges. FLIR cameras are currently used for a wide variety of applications,

A FLIR camera can provide thermal imaging of the environment, which can aid in developing highly accurate data associated with outfall discharges.

including crop analysis, animal physiology and law enforcement.

The camera records temperature differences between the discharge and ambient water, and its fine scale data resolution can adequately record the mixing patterns in structurally complex pierside regions. A validated model utilizing this technology will enable advanced discharge characterization at Navy facilities to meet National Pollutant Discharge Elimination System requirements.

After calibrating the FLIR camera, the project team will demonstrate the utility of FLIR cameras to capture the dynamics of multiple shoreline discharges, and will incorporate FLIR data into three current hydrodynamic models.

EPA supports the use of advanced discharge models that integrate the concepts utilized in this project. Adding additional capabilities to the suite of hydrodynamic models currently used by the Navy (Curvilinear-grid Hydrodynamics 3D (CH3D), CORMIX mixing zone, and Dynamic Mixing Zone models) will strengthen support for and adoption of these models.

Smart Electronic Tools for Navy Environmental Compliance Monitoring and Reporting (project no. 540)

The Department of the Navy is required by EPA to perform compliance monitoring of Navy activities for 44 programs, including stormwater discharge and spill response. Establishing an efficient compliance program requires collection of massive amounts of data. Comprehensive field surveys of Navy installations require several teams of surveyors, each having varying degrees of experience, note-taking habits, penmanship and very limited time. For example, cross connection surveys (surveys of points where potable and non-potable water sources meet) involve labor-intensive activities including field collection of data, review and manual tabulation of data into spreadsheet or database format, resolving discrepancies in identification of hazard types and identifying corrective actions required. Compilation and interpretation of field notes, manual tabulation of data and consistency checks for hundreds of buildings following these surveys are time-consuming tasks. In addition, handwritten data has to be transferred into a digital format.

Many commercial off-the-shelf technologies exist that assist Public Works Departments in collecting data digitally in the field and transferring it to the work station. However, there is an information gap on what electronic devices are acceptable and compatible with the Navy Marine Corps Intranet (NMCI). This project, headed by Itzel Godinez of the Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC), was formed to identify a user-friendly electronic device and software that are currently NMCI-compatible, or could be certified to be NMCI-compatible.

Most field surveys in the Navy are done with pen and paper.
Daniel P. Jackson Norgart

Although integrating a new technology into the NMCI network can be burdensome and time-consuming, this hurdle should not immediately exclude this project. If the technology is successfully integrated into NMCI, end users would reap the benefits indefinitely.

The project team will first seek feedback from the public works department at Naval Base Ventura County (NBVC) in Port Hueneme, California to determine the needs of the user community. Then a market technology survey will be undertaken, and the top two technologies will be

The EcoPower system produces better results, in less time, with greater efficiency, without the associated hazardous waste disposal issues.

delivered to NBVC for feedback. The technology with the most potential will be demonstrated on a small scale at the base. If the demonstration is successful, a statement of work (SOW) will be completed that includes the technology specifications and cost information. The SOW can be then used by any Public Works Department to acquire the technology.

Utility Vault Water Treatment (project no. 541)

All Navy shoreside facilities have a system of underground vaults which provide access to utility systems. These vaults accumulate rainwater and groundwater, which can be contaminated through surface runoff, or through contact with lubricants, oils and rust within the vaults themselves. The accumulated water in these tunnels must be removed if it interferes with maintenance work, and occasionally, to prevent discharge to surrounding waters. Under the National Pollutant Discharge Elimination System (NPDES), this contaminated water is subject to the facility's permit, which requires the installations to generate and comply with a Pollution Prevention (P2) plan. Naval Base Coronado's (NBC) P2 plan includes measures to route pumps and hoses to the local sewer service for manual dewatering, requiring extensive labor and logistical support to set up. Dewatering a utility vault and discharging the accumulated water to the sanitary sewer requires the use of a network of portable pumps or a vacuum truck, resulting in delays when this equipment is not readily available.

This project, led by Pat Morrow of the Naval Surface Warfare Center, Carderock Division, will demonstrate a Hydrocarbon and Contaminants Removal (HCOR) device which has been developed specifically for utility vault dewatering. The HCOR device is a compact filter installed on the outflow of the vault's sump pump prior to discharge. The HCOR device utilizes fine-grain media for hydrocarbon and suspended solids removal. While much of the total contamination will be removed through this filtration media, more robust, chemically reactive measures will be added to reduce the fraction of dissolved metals even more. Additionally, other metal-specific adsorbents will be evaluated for suitability as a finishing or "polishing" step in this process. The combination of these technologies can ultimately prolong the life of the ion exchange media, and meet increasingly stringent discharge requirements.

The demonstration will include the evaluation of the HCOR filtration device along with polishing steps during normal dewatering of the utility vaults located at NBC. This demonstration will include appropriate sampling and analysis to determine the improvement in effluent quality resulting from the use of the following:

- The stock HCOR device on its own.
- The HCOR device with the addition of enhanced metals removal.
- The HCOR device coupled with adsorbent media as an alternative solution to remove metals.


A typical utility vault onboard a Navy installation.

Once these technologies have been evaluated, the most cost-effective option that meets discharge criteria will be made available to Navy sites, along with full operating instructions.

Naval Air Systems Command Solutions for Engine Washing (project no. 542)

NAVAIR maintenance operations require engine washing as a routine part of scheduled maintenance. Current engine washing procedures require the use of a gas path cleaner, which requires thorough rinsing. Occasionally, the rinsing process is insufficient, and dried residual cleaning solution remains in and on the engine. This attracts dirt and contaminants, and can lead to bearing pitting/corrosion, and water migration into the oil—all of which require subsequent maintenance.

The equipment and processes used at Fleet Readiness Centers (FRC), Naval Air Stations, and other maintenance facilities lead to excessive amounts of water usage and insufficient cleaning. In addition, these systems use osmosis water purifiers in combination with mixed bed deionizers. Workers—particularly outside the U.S.—often do not have access to water of sufficient quality; instead using locally available potable water, which rarely meets requirements. Without deionized water, engine washing quality is compromised. Inefficient engine washing operations potentially lead to hazardous waste generation and greater hazardous air pollutant emissions due to excess fuel burning and excess fuel consumption.

This project team, led by Keiko Sapp of FRC East in Cherry Point, North Carolina and Kami Downey of FRC Southeast in Jacksonville, Florida, plans to demonstrate EcoPower™—a cleaning technology that uses heated, deionized, atomized water along with custom manifolds for specific aircraft/engine types to clean the engine. EcoPower is used extensively worldwide in the commercial aviation industry.

This NESDI project is demonstrating a new engine washing procedure for use across NAVAIR. Shown here is an H-53 helicopter engine wash demonstration with the EcoPower small wash unit and effluent collecting kit in place.
David Marriott

This technology works by delivering high-pressure water through a manifold in a droplet size tailored to the engine type. The system deionizes the input water, so any fresh water source is acceptable. At the end of the cleaning process, the effluent is captured, recycled, and cleaned of metal contaminants in a nearly closed-loop system. Recycled water can be analyzed and monitored for contamination buildup to determine when it should be disposed.

Detergent is not required for this system, thus eliminating the challenges associated with detergent buildup, as well as purchasing costs and handling/storage concerns. Additionally, the proposed technology takes about 40 to 60 minutes per aircraft to complete, as opposed to roughly 4–8 hours per aircraft for the current procedure.

In short, the EcoPower system produces better results, in less time, with greater efficiency, without the associated hazardous waste disposal issues and no need for a deionized water supply. The initial phase of this project involves customizing the system for various aircraft platforms including the V-22 Osprey tiltrotor aircraft, H-53 Sea Stallion helicopter, AV-8 Harrier vertical/short takeoff and landing jet aircraft, P-8 Poseidon military patrol aircraft, and C-130 Hercules military transport aircraft. This will be followed by demonstration, performance testing (including an estimation of the hazardous material and hazardous waste handling costs), industrial validation and integration into existing operations.

After successful execution at land-based activities, additional

demonstrations will be conducted in a shipboard environment. Then, the appropriate technical maintenance manuals including the Cleaning and Corrosion Control Manual (NAVAIR 01-1A-509) and the Maintenance Instructions (Organizational and Intermediate Level) Support Equipment Cleaning, Preservation, and Corrosion Control Manual (NAVAIR 17-1-125) will be revised.

Preventative Management of Contaminated Silt (project no. 543)

Sediment contamination in the waterways surrounding Navy facilities may require costly cleanup efforts and operational disruption. Sediment containing contaminants may be found in drydock discharge and process streams. Once this sediment is introduced into the process stream—through the intake of seawater during docking operations—it is managed through cleaning efforts requiring extensive labor and potential delays to industrial work on the ship in dock. Current methods of managing contaminated sediment before reaching the drydock in surrounding waterways are limited to techniques such as dredging and capping, which are expensive and can be operationally and environmentally disruptive.

This project will demonstrate passive sediment collection and dewatering devices that will trap contaminated sediment before it is deposited on the drydock floor, thereby reducing the contaminant waste stream as well as the time and effort needed for drydock cleaning. The devices will be demonstrated at the Puget Sound Naval Shipyard & Intermediate Maintenance Facility (PSNS & IMF) under the leadership of Pat Morrow, Naval Surface Warfare Center, Carderock Division.

The devices chosen for demonstration are clarifying inserts which can be placed into the existing sand traps to capture and retain sediment during drydock flooding and dewatering. A sloped or conical bottom shape coupled with piping connections will allow the inserts to be quickly and effectively flushed out for removal and disposal of silt.

Part two of this demonstration will be the collection of sediment from the area of accumulation outside the drydock apron. This process will precede drydock flooding, reducing the amount of silt that would otherwise flow into the dock when the caisson is removed. Following an initial feasibility study and proof of concept testing, it is expected that this will be accomplished through targeted high solids pumping and recovery devices similar to those used in dredging, but on a much smaller scale.

These two targeted methods of sediment retention bridge the gap between disruptive, expensive, large-scale dredging and capping projects and the time-consuming, inefficient ground crew cleanup that occurs between docking completion and commencement of industrial work.

Once a successful design of the dewatering and sediment removal equipment is demonstrated, additional facilities and additional drydocks at PSNS & IMF will be addressed. The design will allow for the customization of equipment needed for each PSNS & IMF drydock and other Navy drydocks.

Propane is injected into the saturated zone to increase the biological activity of the indigenous microorganisms.

Stable-Isotope Labeled Tracers, an Innovative Way to Validate Natural Attenuation of RDX in Groundwater (project no. 544)

The Navy has multiple sites impacted by munitions explosives contamination. Acceptable limits of RDX (cyclotrimethylene-trinitramine)—the main contaminant of concern—are very low, making site closure difficult to attain when sites have to meet strict cleanup goals. Many Navy installations with RDX groundwater have active remedies in place, such as pump and treat systems, to mitigate any risks associated with these plumes. Active remediation systems tend to have high operating and maintenance costs, and the persistence of RDX tends to limit their overall effectiveness. Often, sites rely on natural attenuation processes to achieve the site-specific remediation goals; however, it is difficult to demonstrate that natural attenuation really is occurring and at what rate.

Headed by Jennifer Segura of NAVFAC EXWC, this project team will conduct a field demonstration based on a

The proposed demonstration site at Naval Base Kitsap Bangor.

technology developed under the Strategic Environmental Research and Development Program (SERDP). This approach uses a stable isotope method for tracking RDX in situ to validate that natural attenuation is occurring and at what rates.

Small natural variations in the composition of isotopes (atoms with small but detectable variations in mass) have proven useful for examining contaminant sources, transport, and processing, particularly in groundwater environments for a variety of contaminants. However, because natural variations in isotopes are small and can arise for several reasons, this method can be an ambiguous tool to attribute sources or calculate transformation rates. In contrast to relying on natural variations in isotopic enrichment, adding an isotope to a contaminant (known as isotope labelling) provides clear source tracking. This technique can uniquely identify the products of RDX degradation, whether they are organic derivatives or true products of complete mineralization the latter constituting natural attenuation.

This project team will introduce a stable isotope-labeled contaminant (RDX) into an existing RDX plume to trace the fate of the parent RDX in the environment.

The demonstration is proposed to take place at Naval Base Kitsap Bangor. The well-established "push-pull" technique will be used to introduce stable isotope-labeled ^{15}N-RDX into the RDX plume. The plume will be monitored for production of RDX mineralization products containing the ^{15}N tracer. Natural attenuation rates will then be calculated from these measurements. This demonstration will provide substantial data that can be utilized to transition sites from active to passive remediation with regulator acceptance.

The project's final report will be distributed to Remedial Project Managers for those sites impacted by RDX. Results of the project will also be discussed with relevant working groups and presented at major conferences.

In Situ Treatment of 1,4-Dioxane Using Enhanced Biodegradation (project no. 545)

The DoD has over 100 sites with measureable concentrations of 1,4-dioxane in their groundwater, and many of these have high enough concentrations to require treatment. Although a number of potential remedies have been examined, these all tend to be either prohibitively expensive or ineffective, and the Navy does not have a cost-effective solution that can be implemented immediately.

The objective of this project is to demonstrate a new, cost-effective treatment method for reducing or removing concentrations of 1,4-dioxane from groundwater at Navy sites.

Enhanced in situ aerobic bioremediation is the process of stimulating indigenous oxygen-dependent microorganisms to degrade contaminants in groundwater and in the aquifer matrix. Bacteria with the capacity to biodegrade 1,4-dioxane are augmented with auxiliary substrates to induce the required enzymes and support co-metabolic degradation.

Preliminary studies have revealed propane biosparging to be effective for bioremediation of 1,4-dioxane. Biosparging technology uses indigenous microorganisms to biodegrade organic constituents. In this process, propane is injected into the saturated zone to increase the biological activity of the indigenous microorganisms. If necessary, oxygen and nutrients are also injected to make for ideal conditions for biodegradation.

This project team, headed by Timothy Appleman of NAVFAC EXWC, plans to leverage the results of treatability

Real-time multi-level monitoring of remedial amendment injection.
GSI Environmental, Inc.

studies conducted at Rice University on a separate project. The most promising bacteria strains identified in these studies will be fermented and characterized by their suitability for production scale-up.

The project will then move into the pilot test phase. The design of the pilot test will be tailored to meet the characteristics of the selected test site. The general structure of the pilot test will involve the injection of an amendment solution consisting of a tracer plus a co-metabolic substrate into a well or wells. At a nearby well(s), an amendment solution consisting of a tracer, co-metabolic substrate and a bioaugmentation culture will be injected. Consequently, this design will provide data to compare biostimulation with bioaugmentation. Postinjection monitoring will occur periodically through a series of groundwater extractions from test well(s). The success of the demonstration will be tied to decreasing concentrations of 1,4-dioxane, and the transformation capacity and rates which will help determine the feasibility of designing a full-scale in situ biostimulation system.

National Pollutant Discharge Elimination System (NPDES) Copper Effluent Control System (project no. 546)

Over the past several years, regulatory levels for copper in stormwater runoff have become more stringent across the country. Meeting these requirements is particularly problematic at Navy shipyards and drydocks where multiple point and non-point sources of copper exist. In addition, effluent levels vary temporally, and are especially sensitive to rain events, which triple effluent concentrations. National Pollutant Discharge Elimination System (NPDES) -regulated copper concentrations are based on total copper, which includes all forms (dissolved and bound). Most copper in runoff is in the form of the bound or particulate forms, which are less bioavailable and less toxic than the aqueous (dissolved) form. Conversion of the more toxic forms of copper to the less toxic forms can be environmentally protective, but its regulatory utility has not yet been adopted in some Navy locations.

The ability to measure all forms of copper and demonstrate how much of the metal is bioavailable will aid with analysis of NPDES levels.

As each shipyard has its own unique conditions, no single treatment technology will be able to cost effectively clean all shipyard and drydock effluents. This project team, led by Iryna Dzieciuch of SSC Pacific, will demonstrate an automated approach to selecting appropriate technologies and monitoring their effectiveness.

The Navy Copper Analyzer (NCA) is the latest generation of automated real-time copper analyzers developed at SSC Pacific and demonstrated under the NESDI program and the Environmental Security Technology Certification Program (ESTCP). The NCA is the only instrument capable of measuring all three forms of copper (whole, dissolved and bound) in effluents, in situ and in near real-time at environmentally-relevant concentrations.

The use of pulsed (intermittent) toxicity exposures has been documented in several studies as an effective way to characterize toxicity in water bodies.

This precise real-time control system is also capable of diverting copper-laden runoff to the appropriate coordinated treatment systems, without impeding the flow of effluents that are in compliance with regulations. This would result in a significant reduction in treatment technology footprint, and operational cost savings versus treating all effluent with a single technology. This system will also be capable of measuring and controlling the diversion of stormwater, cooling water, or wastewater in drydocks, treatment plants, or receiving waters.

The NCA will be laboratory tested and field tested at Pearl Harbor Naval Shipyard & Intermediate Maintenance Facility, where the regulatory level is many times lower than current discharge levels. Grab samples will be collected and measured using approved EPA methods. These results will be compared with the field readings of the NCA.

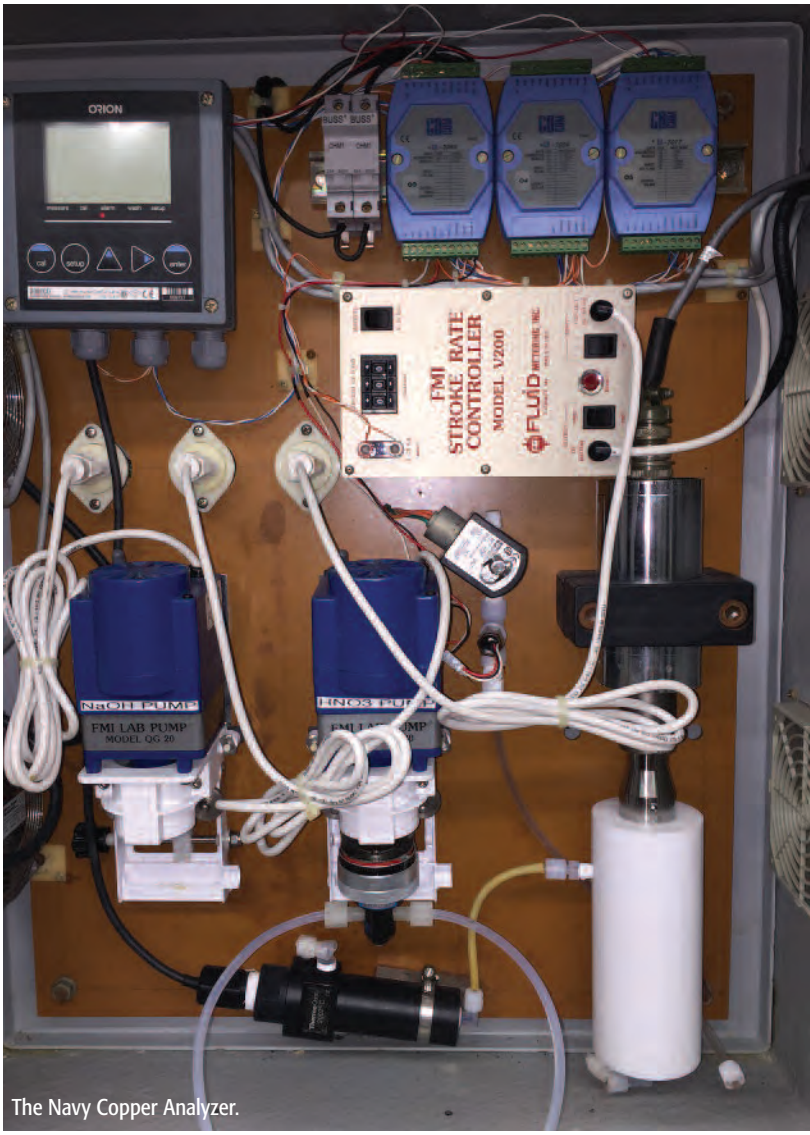
Demonstration of Improved Toxicity Methodology to Link Stormwater Discharges to Receiving Water Impacts at Navy Sites (project no. 547)

The Navy is required to comply with increasingly stringent water quality requirements associated with industrial stormwater discharges. These requirements generally specify end-of-pipe monitoring. However, this type of monitoring—measuring contaminants at the outfall point—is problematic because the exposure conditions at the end-of-pipe are not static. Also, this type of monitoring does not account for the changing magnitude and extent of exposure when contaminants mix in the larger body of water.

One commonly used test method, Whole Effluent Toxicity (WET) testing, was developed to provide a better picture of continuous point source discharges by taking into account factors such as contaminant bioavailability, and some of the complex effects associated with exposure to multiple contaminants, many of which may not be monitored. However, WET methodologies still assume continuous discharges, likely overestimating the toxicity associated with the infrequent and episodic nature of stormwater discharges.

This project plans to identify a more environmentally relevant approach to assessing stormwater toxicity by taking into account actual exposure conditions both at the end-of-pipe and in the receiving water.

The use of pulsed (intermittent) toxicity exposures has been documented in several studies as an effective way to characterize toxicity in water bodies, in part because pulsed exposures are more characteristic of real-world conditions.



The Navy Copper Analyzer.

The team, led by Marienne Colvin of SSC Pacific, will leverage work already sponsored by the NESDI program and others to gather historical data on rainfall and mixing zone dynamics at several DoD facilities. These data, and the results of other pulsed toxicity studies, will be used to conduct laboratory testing using relevant contaminants of concern and permit-relevant species.

Concurrent end-of-pipe monitoring and in situ water body monitoring will then be initiated, using passive Sediment Ecotoxicity Assessment (SEA) ring samplers. Using the data gathered in the first two steps as a guide, exposures will be varied by time and concentration. The goal is to

paint a more accurate, scientifically defensible picture of real-world stormwater discharges and their impact on the water body.

At the end of the project, a user's guide will be produced for permit writers and Navy water quality managers. The development of a final report will also be coordinated with the San Diego Regional Water Quality Control Board to seek regulator acceptance of the technology.

Stormwater discharge at the onset of a rain event (TOP) and less than 24 hours later (BOTTOM) showing episodic nature of events at end-of-pipe and in the receiving environment. This project will demonstrate and validate a more accurate exposure design for laboratory toxicity testing to support improved stormwater discharge monitoring at this and many other outfalls on Navy installations.

Chris Stransky

Sewer Gas Elimination Technology (project no. 548)

The wastewater infrastructures at many Navy installations have been beset with sewer gas problems for decades without an effective remedy. Sewer gas often contains hydrogen sulfide (H_2S), methane, and other noxious gases. H_2S can cause corrosion of concrete sewers and pump station infrastructure, and can be lethal to humans at concentrations ranging from 100 to 500 parts per million.

This project plans to demonstrate ozone injection technology as a way to mitigate the generation and release of noxious and toxic gases in sanitary sewers.

H_2S is generated when sulfates are converted to sulfides by sulfate-reducing bacteria. Sulfates are universally present in stormwater and water rich in decaying matter, such as wastewater. Under the anaerobic conditions prevalent in sewer systems, sulfate-reducing bacteria, and therefore, H_2S, can thrive. The low-flow velocities found in many sewer systems allow the settling of organic matter, and this can cause anaerobic conditions and exacerbate the growth of this bacteria.

Additionally, the intermittent operation of pumps in pump stations results in the generation of high levels of H_2S gas. This gas may escape the system via manholes, drains, or malfunctioning sewer traps. This presents nuisance odor conditions, and health and safety risks, requiring increased expenditures for sewer infrastructure rehabilitation. Further, dissolved sulfides produced by bacterial reduction of sulfates present in the wastewater can exceed local dissolved sulfide discharge limits, triggering permit violations.

Ozone inhibits the growth of sulfate-reducing bacteria, and thereby limits the generation of associated noxious gases. Ozone can be safely and simply generated from ambient air, providing an effective option that is more sustainable than conventional sewer gas elimination strategies.

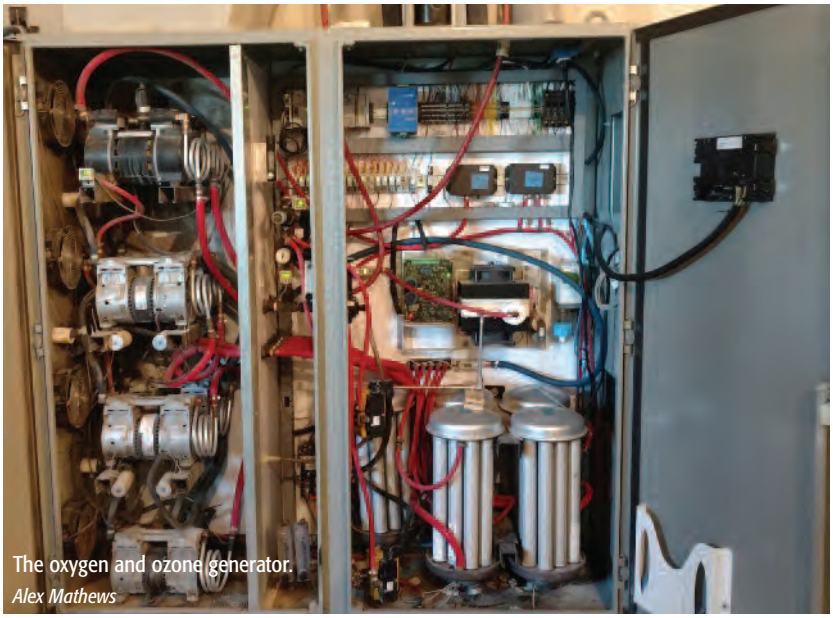
Team members, led by Steven Fann of NAVFAC EXWC, will demonstrate an ozone injection system at Naval Air Station Coronado. After a six month monitoring period to establish baseline conditions and quantify the extent of the problems, the team will dissolve ozone in water and apply it as a solution into the sewer. Gas levels will be monitored regularly, and the results of the demonstration will be compared with previous nitrate and ferrous salt injection demonstrations to develop a comprehensive method for the elimination or drastic reduction in emission of H_2S and other gases from sewers.

During project planning, the team will coordinate with the City of San Diego to gain acceptance of the technologies to be tested during this project. During the demonstration, the team will also invite interested parties from the Naval Facilities Engineering Command Southwest to the demonstration site for an overview off the technologies. The team also plans to work with end users via regional offices, and participate in Media Field Team meetings.

Demonstration of Optimized non-NMP (n-Methyl-2-pyrrolidone) Solvents for Immersion Chemical Depainting (project no. 549)

All of the products currently qualified per the MIL-PRF-83936 specification (Remover, Paint, Tank Type, for Aircraft Wheels, Landing Gear Components, and Other Aircraft) contain n-Methyl-2-pyrrolidone (NMP), which is classified as a reprotoxin, due to its detrimental effects on the reproductive system. NMP is a reportable constituent on the Toxic Release Inventory. It is also regulated as a chemical under the California Office of Environmental Health Hazard Assessment and as a European Chemicals Agency Substance of Very High Concern. An alternative non-NMP paint remover is needed.

Efforts are underway through the Defense Logistics Agency's Hazard Minimization and Green Products Program to revise the specification and to perform an initial demonstration of alternative, non-NMP materials to demonstrate acceptable performance. One product (D-Zolve 1533 IM), showed promise in early trials, but raised several concerns: the product evaporated rapidly, was easily removed from the component part, and emitted a strong odor. Through leveraged work with the Aircraft Equipment Reliability and Maintainability Improvement Program, the formulation is being optimized for the field application to correct these issues. The reformulated product will also enable the stripping bath temperature to be increased to improve stripping efficiency. Currently, the product is limited to operation at 120 to 125 degrees Fahrenheit because higher temperatures affect additional evaporative losses.



The oxygen and ozone generator.
Alex Mathews

If the reformulated product is suitable, this project, led by Joseph Santa Maria of FRC Southeast, will begin with a full demonstration/validation to validate its performance and ensure its compatibility with existing infrastructure.

Before the demonstration/validation can take place, the project team will perform coupon tests utilizing small squares or "coupons" of different substrates and various finish systems. The new formula will be compared to a control product that is currently qualified to MIL-PRF-83936. The product will be tested for paint removal performance, corrosion, strip rate, paint adhesion and hydrogen embrittlement. After the coupon testing, scale-up testing will take place at FRC Southeast to demonstrate and validate the new product for stability and maintainability, to establish process controls for quality improvement and to develop engineering documentation.

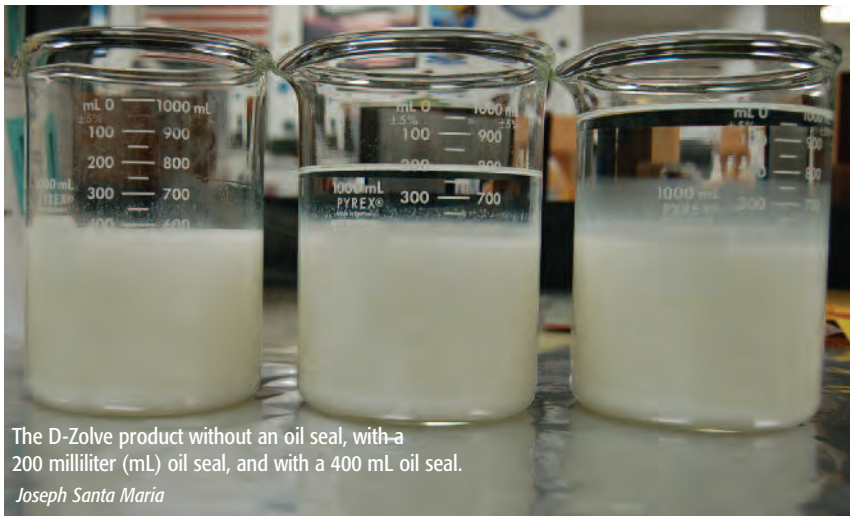
The non-NMP product will likely be a drop-in replacement for current products because the evaporation retardant will not likely affect the products' properties. In FY18, the plan is to revise the applicable technical manuals, Local Process Specifications, general series manuals, or and/or NAVAIR authorization letters in accordance with the new specification qualifications to prescribe the use of the new chemical at other facilities.

A Comprehensive Analysis and Strategy for Contaminated Sediment Management (project no. 550)

Contaminated sediment management is broadly estimated to be a one billion dollar problem for the Navy. The actual cost of managing these sites could be

even higher, since costs often grow as a site progresses from feasibility study to Record of Decision (ROD) to remedy design, to implementation. A systematic review of how and why these costs grow is needed.

This project was formed to prepare an Initiation Decision Report (IDR) to guide investments in the sediment remediation area.


The D-Zolve product without an oil seal, with a 200 milliliter (mL) oil seal, and with a 400 mL oil seal.
Joseph Santa Maria

At most remediation sites, the understanding and tools for determining the nature and extent of the contamination, the limitations of existing characterization tools and the shortcomings of current remediation and performance monitoring technologies are still evolving, as is understanding of regulatory/stakeholder expectations. Therefore, decision-making often occurs at every stage based on incomplete information.

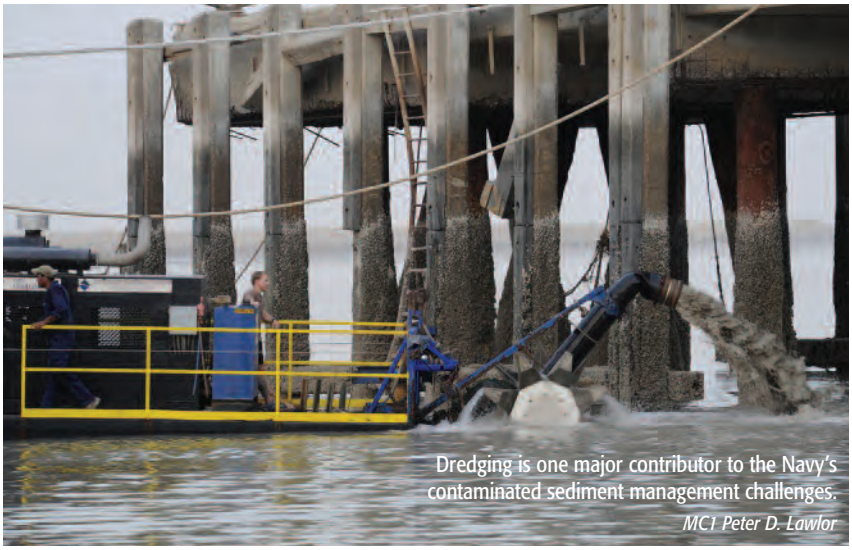
The IDR will provide technical insights into and analysis of the sediment marketplace, identifying information gaps and limiting factors, such as Navy or regulatory policies. The report will indicate where sediment research, development, test and evaluation investments should be made to fill these gaps, and which technologies are ready for demonstration/validation today.

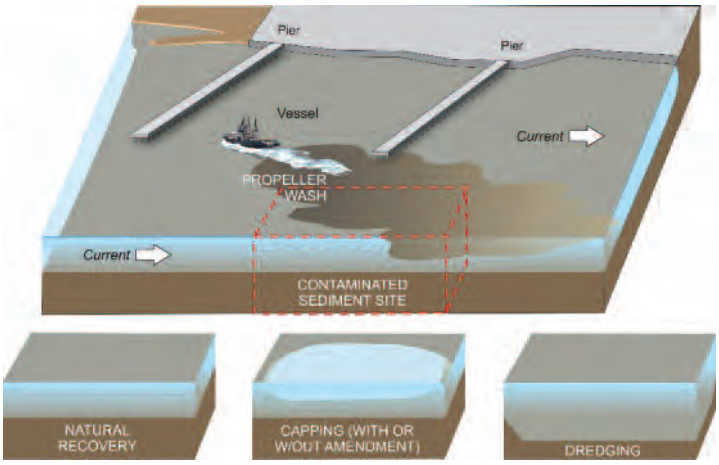
The project team, headed by Joey Trotsky of NAVFAC EXWC, will gather broad input from Remedial Project Managers in the Navy as well as non-Navy stakeholders (including the EPA, Army Corps of Engineers, individual states and others). Recent remedial investigations, feasibility studies, and RODs will be examined to identify end user-driven research needs for possible future NESDI investments.

The IDR will be disseminated through multiple technology mechanisms. Discussion of IDR results will also be presented to NAVFAC's Contaminated Sediment Workgroup and Alternative Restoration Technology Team. The report may also be incorporated into additional training seminars.

Impact of Sediment Resuspension by Propeller Wash and Shore Sediment Dynamics on Remediation Options (project no. 551)

While there has been significant progress toward both the identification and remediation of contaminated sediments at DoD harbors and waterways, there is a lack of understanding and public confidence on the effectiveness and permanence of these actions. Short-term remedial actions such as removal, and long-term actions such as capping and monitored natural recovery may be affected by site conditions such as propeller wash and wave action. This project, headed by Pei-fang Wang of SSC Pacific, was formed to provide more information regarding the effectiveness of various sediment remediation methodologies under real world stressors.


Dredging is one major contributor to the Navy's contaminated sediment management challenges.
MC1 Peter D. Lawlor



Propeller wash impact model. Processes include resuspension of contaminated sediment, near field mixing and re-deposition, far-field transport and re-deposition, and washing (with a portion of the sediment mass washed out of the harbor).

The Basics About the NESDI Program

THE NESDI PROGRAM is the Navy's environmental shoreside (6.4) Research, Development, Test and Evaluation program. The program is sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division and managed by NAVFAC out of NAVFAC EXWC in Port Hueneme, California. The program is the Navy's complement to ESTCP which conducts demonstration and validation of technologies important to the tri-Services, EPA, and the Department of Energy.

For more information, visit the NESDI program web site at www.nesdi.navy.mil.

Sediment dynamics in harbors and shore regions are complex. The potential for resuspension of contaminated and remediated sediments, remigration of these suspended sediments to other areas, and recontamination of remediated areas by particles generated from other ongoing sources, complicate the performance of remedial actions. Under this project, a rigoros study will be conducted at Naval Base San Diego (NBSD) to examine the effect of sediment resuspension dynamics by propeller wash and shore sediment dynamics (wave action) on short- and long-term remedial options.

Issues covered will address how propeller wash may affect the stability and effectiveness of each remediation technique and how propeller wash and shore sediment dynamics may affect water quality and sediment recontamination.

Two protocols will be developed and demonstrated—one for the evaluation of the effect of resuspension events, the other for the evaluation of recontamination potential.

The protocols are based on data specific for the study site, for which numerical models have been previously validated. Existing estimates of daily tugboat activity at NBSD will be used to characterize and quantify resuspension by propeller wash. These data, in conjunction with baseline sediment chemical characteristics and calculations from the previously developed models, will help to determine the impact of propeller wash on each of the three sediment remediation options, including natural recovery, capping and dredging.

The knowledge and modeling tools to be developed will also be applied for intertidal shallow shoreline areas, where remediated sediment undergoes persistent and repetitive resuspension, migration and redeposition processes.

This project also leverages ongoing work sponsored by ESTCP and SERDP.

At the end of the project, the team will develop a report to help Navy Remedial Project Managers design and select remediation options for contaminated sediment sites where propeller wash and other factors may be an issue. ⚓

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